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REPORT OF THE UNITED NATIONS/EUROPEAN SPACE AGENCY WORKSHOP ON APPLICATIONS OF SPACE TECHNIQUES TO COMBAT NATURAL DISASTERS, ORGANIZED IN COOPERATION WITH THE GOVERNMENT OF MEXICO

(Mexico City, 27-30 September 1993)

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INTRODUCTION

A. Background and objectives

1. On 10 December 1982, the General Assembly adopted resolution 37/90 in which it endorsed the recommendations of the Second United Nations Conference on the Exploration and Peaceful Uses of Outer Space. In that resolution, the Assembly decided, among other things, that the United Nations Programme on Space Applications should disseminate, through panel meetings and seminars, information on new and advanced technology and applications, particularly for the benefit of the developing countries.

2. The United Nations/European Space Agency (ESA) Workshop on Applications of Space Techniques to Combat Natural Disasters, was one of the activities of the Programme for 1993 that were endorsed by the General Assembly in its resolution 47/67 of 14 December 1992. The Workshop was organized in cooperation with the Government of Mexico. It was hosted by the Instituto Mexicano de Comunicaciones (IMC) at Mexico City, from 27 to 30 September 1993, for participants from developing countries of the region of the Economic Commission for Latin America and the Caribbean (ECLAC).

3. The objectives of the Workshop were: to expose the participants, particularly the managers of emergency response agencies, to ways and means through which space technology (remote sensing, satellite meteorology, satellite communications, positioning by satellites) could be utilized to prevent or mitigate the effects of natural disasters; and to address the development of databases and their use with Geographic Information Systems (GIS) to prevent disasters or to monitor, mitigate and redress the effects of disasters when they occur.

4. The presentations at the Workshop addressed the use of remote sensing, satellite meteorology, satellite positioning systems and satellite communications and how they could be used, separately or collectively, to prevent disasters or to forecast, monitor and mitigate the effects of severe weather phenomena (such as flooding, drought and regional and global phenomena like El Niño). The presentations also addressed the extent to which the same technologies could mitigate the effects of earthquakes and volcanic eruptions. The Workshop concluded with working group discussions of the needs of the emergency response services, the capabilities of space technology to satisfy those needs and the actions that would be necessary in the short- and medium-term to take advantage of those capabilities.

5. The present report, which covers the background, objectives and organization of the Workshop, the observations and recommendations made by the participants, as well as a summary of the lectures presented, has been prepared for the Committee on the Peaceful Uses of Outer Space and its Scientific and Technical Subcommittee. The participants will report to the appropriate authorities in their own countries.

B. Organization and programme of the Workshop

6. The participants were professionals with several years of experience in managerial positions with national and regional emergency response agencies and services. Other participants had several years of experience in remote sensing, satellite meteorology and the use of databases such as GIS. Sixty-nine experts from 19 Member States of the United Nations and five international and regional organizations participated in the Workshop; 57 of the participants represented 17 developing countries from the ECLAC region.

7. The Workshop was attended by participants from the following countries and international organizations: Argentina, Barbados, Bolivia, Canada, Chile, Colombia, Ecuador, France, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, Peru, Spain, Trinidad and Tobago, United States of America, Uruguay; Department for Humanitarian Affairs, Office for Outer Space Affairs, Caribbean Community, Caribbean

Disaster Emergency Response Agency (CDERA), the European Space Agency (ESA) and International Maritime Satellite Organization (INMARSAT).

8. Funds allocated by the United Nations and ESA were used to defray the cost of air travel and an allowance for incidental expenses of 19 participants from 16 developing countries of the ECLAC region. The Government of Mexico, through IMC, provided room and board for these same participants. The Instituto de Geografía, Universidad Nacional Autónoma de México, provided the conference facilities, and the Government provided local transportation for all participants in the Workshop.

9. Opening addresses were made by E. Mendez, Director General of IMC, on behalf of the Government of Mexico, V. Hood, the representative of ESA, and the Expert on Space Applications, Office for Outer Space Affairs of the United Nations.

10. The programme for the Workshop (see annex), was developed jointly by the United Nations and ESA in consultation with IMC. The Workshop was conducted through a number of plenary and working group meetings. At the latter, the participants discussed the issues related to the use of space technologies to prevent and combat the effects of natural disasters and concluded the meetings with the observations and recommendations presented below.

I. OBSERVATIONS AND RECOMMENDATIONS OF THE WORKSHOP

A. Observations of the Workshop

11. The Workshop noted that within the last 25 years, natural disasters had affected more than 800 million persons, of which about 3 million had lost their lives, and that the associated economic losses were in the range of 25 billion to 100 billion United States dollars (US$).

12. The Workshop also noted that developing countries were particularly subject to natural disasters on a scale that overwhelmed the capacity of the societies concerned to cope with their aftermath. In many cases, just one such destructive episode was sufficient to destroy the social and economic infrastructure, including the communications network. In such cases, a single major disaster could disrupt the distribution of food and water supplies, the medical services, and both the local and the international communication links of the stricken communities.

13. The Workshop noted that many of the national and regional emergency response agencies and services were not aware of the full spectrum of applications of space technology. Of particular concern was the lack of awareness of the Earth-observing systems that could provide essential data for the prevention of disasters or for the mitigation and relief of their effects. To a lesser degree, the same observations applied to satellite communications, particularly regarding recent developments in mobile communications. In case of disaster, such technology could restore communications with the local headquarters for rescue and relief operations as well as with the outside world.

14. The Workshop noted that, on a recurring basis, groups of countries in the Latin America and the Caribbean region experienced specific natural disasters that were common to them because of their geographic location. For instance, countries on the Pacific coast suffered frequent seismic activity, while countries in the Caribbean region were particularly vulnerable to hurricanes and violent tropical storms.

B. Recommendations of the Workshop

15. The Workshop recommended that one of the first actions should be the establishment of a coordination mechanism among the institutions responsible for the prevention of natural disasters and for the mitigation of their effects. Such a mechanism should be kept simple enough to be implemented in the very near future, and should be efficient in providing institutions with references to data and to ancillary information available through space technology. The responsibility for establishing the coordination mechanism described below would rest with the participants in the Workshop. The United Nations and ESA would cooperate in initiating the process by distributing the report of the Workshop among the participants.

16. The coordination mechanism proposed by the Workshop was the establishment of focal points in the three subregions of the Americas (North America, Central America and the Caribbean, South America) and the identification of local contact points in each country.

17. The responsibilities of the local contact points would be as follows:

(a) To conduct an inventory, at the institutional level, of the human resources available;

(b) To conduct an inventory of the equipment and physical infrastructure available in the institutions involved in disaster-related activities;

(c) To establish a list of the information available at the institutions, with appropriate references;

(d) To draw up a list of ongoing or planned projects relating to the prevention of disasters or the mitigation of their effects;

(e) To prepare a list of the main problems and needs of the institutions charged with planning for or conducting emergency response and relief operations;

(f) To establish and maintain simple yet fluid communications with the corresponding focal point.

18. The responsibilities of the focal points would be:

(a) To receive and collect the information coming from the local points and from other sources. Where feasible, the information should be analysed and synthesized;

(b) To transmit referral-type information from the local points to the international space organizations and agencies and vice versa;

(c) To coordinate with other focal points;

(d) To facilitate contacts between projects with common interests;

(e) To publish periodically a bulletin of general information for the emergency response services. In this connection, the focal points should explore with the Sociedad de Especialistas Latinoamericanos en Percepción Remota (SELPER) the possibility of including the periodical bulletin within the SELPER Bulletin;

(f) To request international space organizations and agencies to distribute relevant documents and materials directly to the local points and provide technical assistance and financial support, particularly for training courses and workshops.

19. To achieve the above aims, the participants in the Workshop set themselves the following work schedule:

(a) To identify the focal points and local contact points by mid-February 1994;

(b) To complete, by the end of February 1994, the general distribution of the names and addresses of the focal points and local contact points and of the institutions involved in disaster-related activities;

(c) To present the above-mentioned information at a regional meeting to be held in March 1994 at Cartagena, Colombia, to enable countries to share their experiences in preventing disasters and in mitigating their effects.

20. The Workshop recommended that national and regional emergency response and relief agencies, in close cooperation with their scientific and technical communities, should exchange information and share or develop ad hoc databases concerning disasters that affected them frequently. In some instances, the databases should be linked through a network to enable the information and data to be accessed in a timely manner.

21. The Workshop also recognized that because of the global causes and effects of some natural disasters, there was a need for a global system that could provide early warning and support for relief operations in emergency situations.

22. The Workshop indicated that such a system should follow the concepts contained in the Global Emergency Observation and Warning (GEOWARN) system, developed during the 1993 summer session of the International Space University. In other words, such a system should be politically neutral, should operate on an international, non-profit basis, and should be accessible to all countries.

23. For planning purposes, as well as to facilitate relief and rescue operations, it was essential that national and regional emergency response services should have information that identified high-risk areas by type and degree of risk.

24. The Workshop recommended that the Government of each country should develop and implement national policy that would create or expand databases that could be used to generate potential risk and vulnerability maps. The databases should include relevant cartography, data on past occurrences of disasters and information on conditions that would increase the potential for disasters (such as the nearness of population centres). To facilitate data analysis and achieve the capability of incorporating data received in near real-time from satellites or from sensors in the field, existing cartography should, to the extent possible, be digitized and incorporated into a GIS.

25. The Workshop emphasized the importance of building a disaster information database and developing appropriate communications networks to monitor the occurrence of natural disasters.

26. The Workshop became aware that considerable of work in building such databases had already been done, and recommended that a network for monitoring earthquakes and tectonic displacement in the Caribbean and adjacent areas should be further developed. The network would link a communications and data-processing centre, using satellite communications, with civil defence and emergency response centres throughout the region. In that respect, the Workshop encouraged both individual scientists and institutions to work with funding agencies with a view to building such a database and to establishing the network. Once developed, such a facility should be extended to include all countries in the ECLAC region.

II. SUMMARY OF THE PRESENTATIONS

27. In recent years, the magnitude, frequency and far-reaching consequences of disasters of natural, technological or ecological origin had forced the international community to awaken to the large losses of human life and economic resources. According to the United States Research Council, between 1967 and 1987 natural disasters had affected more than 800 million persons, including 3 million deaths, with an associated economic cost quantified at between US$ 25 billion and US$ 100 billion.

28. A single hazardous event could destroy crops, buildings, highways, ports and dams. In Armenia alone, the economic losses that resulted from a recent devastating earthquake was estimated by experts to be in the range of US$ 20 billion to US$ 40 billion. At Managua, the 1972 earthquake left more than 10,000 dead, 20,000 injured and three fourths of the city's population of 300,000 homeless. That single event caused damage equivalent to one year's gross national product, and disrupted virtually the entire industrial infrastructure of Nicaragua.

A. New possibilities in satellite communications

29. In spite of the tremendous damages caused by major disasters, the appropriate application of new and developing satellite technologies could aid in the mitigation of their devastating effects. New low-cost mobile communications by satellite would play a major role in reducing the effects of natural disasters, and complement and enhance existing terrestrial and fixed satellite services. Such technology would improve disaster preparedness, early warning and onset and post-disaster relief operations.

30. Suitable contingency plans could help minimize the impact of natural disasters. This would typically include the pre-positioning of emergency supplies and communications equipment at strategic locations in areas known to be at risk. As the process of needs identification, funding and deployment could take many months, such activities should be started as soon as possible. In addition to contingency plans, it was essential that designated local personnel should undertake training and regular reviews to ensure that they were ready to operate mobile satellite communications when a real disaster occurred.

31. Another requirement for good contingency planning was to simplify and streamline reporting from the field, so that all relevant information could be transmitted speedily and accurately. One way was to use standardized forms, which could also be made computer-compatible. By such means, even long lists and reports could be compiled quickly and transmitted via mobile satellite communications to disaster relief coordinators and other relevant agencies. For more complex needs, software programs (such as the SUMA program developed for the World Health Organization and the Pan American Health Organization) were already available for use in the management of supplies and personnel from the home base.

32. The agencies typically involved in planning disaster communications were national civil defence and preparedness organizations. The International Committee of the Red Cross and other medically oriented organizations also participated. Virtually every country in Central America, South America and the Caribbean had expressed interest in mobile satellite communications. While the level of technical ability and understanding of the technology was steadily increasing, the main stumbling-block was the lack of funds. Nevertheless, much activity was carried out on a regional basis. For example, CDERA, which coordinated disaster emergency activities of 14 islands, had established a pilot project using INMARSAT terminals as part of their plan to increase emergency preparedness.

33. As of October 1993, INMARSAT, an internationally owned cooperative, had 72 share-owning member countries. Established in 1979, it was the only global provider of mobile satellite communications for distress, safety as well as commercial applications at sea, in the air and on land.

34. INMARSAT comprised three bodies: the Assembly of Parties as the highest organ; the Council, consisting of 22 representative signatories, acting in a fashion similar to the board of a company; and the Directorate. The INMARSAT Directorate had its headquarters in London, with a staff of about 600 and some 50 nationalities.

35. INMARSAT terminals coupled with appropriate sensors could provide Supervisory Control and Data Acquisition. Such equipment could play a vital role in providing or improving the monitoring and early warning functions, even from the most remote areas. Examples of early warning applications using satellites included the monitoring of geothermal and volcanic variables, tectonic plate movement and pressure ridges to help identify potential volcanic or earthquake activity. Mexico had already established a line of seismic sensors along the most vulnerable part of its west coast using radio frequency links, which would be replaced by satellite links because of their lesser susceptibility to the effects of natural disasters.

36. When a disaster struck, telecommunications were often disrupted or rendered ineffective. It could be many hours before the world was even aware of a disaster. Frequently, there was a considerable delay between the onset of the disaster and the arrival of the first relief workers, and that in turn led to valuable time being lost.

37. Good contingency planning, preparation and access to mobile satellite communications enabled local authorities and relief teams to communicate with each other as well as with the outside world immediately. This enabled the experts to make an initial assessment of the damage, report the facts (including transmissions of photographs and videotapes) and request appropriate aid in the critical first 48 to 72 hours when the potential for saving lives was at its greatest.

38. Some of the most notable uses of INMARSAT by international rescue teams were in the aftermath of the earthquakes in Armenia (1988), the Islamic Republic of Iran (1990) and Turkey (1992), as well as during the volcanic eruption in the Philippines in 1991. INMARSAT was extensively used during the devastation of the island of Montserrat by hurricane Hugo in 1989, when all the communications links of the island, including fixed satellite and cable, were destroyed. INMARSAT communications had been used in the aftermath of typhoons and floods in Bangladesh and China (1991), cyclone Val in Western Samoa and the Indian earthquake and floods that occurred in September 1993.

39. The basic components of a satellite communications system were the space segment and the ground segment (the ground receiving stations). For most developing countries, the main concern in investing in satellite communications was the cost and availability of Earth stations. Mobile Earth terminals (MES) were a new type of currently developing Earth station that could be utilized by craft on land, at sea and in the air. The capabilities of such terminals were increasing, while their size and cost of acquisition and use were diminishing.

40. MES of all types were currently in operation. They were purchased, leased or rented from manufacturers, their agents, system integrators or rental agencies. Given the variety of the equipment available, the user could choose one that met the needs in terms of functionality, size, weight, power consumption, service, cost and delivery.

41. For disaster relief and emergency assistance operations, a number of communications terminals could be used, including any of the INMARSAT-A, -M, -B or -C terminals. INMARSAT-A terminals offered high-quality telephone and telefacsimile data and telex or high-speed data (55-64 kilobits per second) channels. The system provided direct dialling to any telephone or telex machine throughout the world. In the other direction, terrestrial subscribers could call the transportable station, while the transportables could also communicate directly with each other. INMARSAT-M was a smaller and cheaper mobile satellite telephone. The latest system was fully digital. It was designed to provide good-quality voice, telefacsimile

and data transmission at 2.4 kilobits per second. An INMARSAT-M terminal was lightweight (8-14 kilograms including a battery) and cheaper to operate than INMARSAT-A. INMARSAT-B was the digital successor to INMARSAT-A. It offered increased functionality at lower charges, including a very high-quality voice transmission along with telefacsimile, telex and data at rates of up to 16 kilobits per second. One compact portable terminal weighed around 18 kilograms.

42. Although telecommunications were high on the list of priorities during the rehabilitation and reconstruction phase following a disaster, it could be weeks or even months before the communications infrastructure was back to normal. During that period, mobile and transportable satellite communications supported the rehabilitation work, enabling local government and business to function.

43. Many natural disasters had a longer-term impact on the region where they occurred. They could cause hardship and dislocation of people, whose needs continued after the disaster had vanished from the news headlines. The management of supplies from the outside world and possible subsequent redevelopment work were frequently aided by satellite communications.

B. Meteorological satellite data for monitoring the Earth

44. Meteorological satellites monitored the Earth's atmosphere, ocean and land surface areas almost in real-time from geosynchronous orbit. Those satellites included the Geostationary Operational Environmental Satellites (GOES-1 and -2) operated by the United States, Meteosat, operated by the European Organization for the Exploitation of Meteorological Satellites, the Geostationary Meteorological Satellite operated by Japan, and the Indian National Satellite operated by India. Their capacity to provide synoptic observations of regional cloud distributions, atmospheric and ocean temperature, relative humidity, wind velocity, distribution of precipitation and other parameters that could be derived from the satellite images had become essential elements in weather forecasting. Among the latter, two of the most useful parameters that could be derived from the satellite data were cloud-top temperature and height.

45. Polar-orbiting meteorological satellites provided a higher spatial resolution than their geosynchronous counterparts. Such satellites provided global coverage of the Earth twice every 24 hours, and could be used to determine sea surface temperature with much higher accuracy than what could be achieved from the geostationary orbit. Land-surface data obtained by such satellites had been found particularly useful, though inexpensive, in determining green bio-mass indices that were used to monitor the encroachment of the desert into previously vegetated areas, which marked the onset of a slowly developing disaster. The polar-orbiting meteorological satellites were operated by the United States (NOAA-N series) and by the Russian Federation (Meteor series).

46. Although their spatial resolution was relatively low, the geostationary and polar-orbiting meteorological satellites together provided operational and high-frequency coverage of the entire Earth at very low cost. Thus, the use of their data in disaster prevention and mitigation of their effects should be easily achievable by most national and regional emergency planning and response services.

C. Use of data from remote-sensing satellites

47. Remote-sensing or Earth-observing satellites were also placed in polar orbits. They were distinguished from meteorological satellites by the higher spatial resolution achieved by their sensor systems. While the meteorological satellites had spatial resolutions ranging from several kilometres to several hundred metres, remote-sensing satellites provided a resolution of the order of a few metres. Only two remote-sensing satellite systems could be called operational. Those systems were the Experimental Earth Observation Satellite (SPOT), originally developed by France and currently operated by SPOT Image Corporation, and Landsat, originally developed by the United States and currently operated by the Earth Observation Satellite Company.

48. The high spatial resolution of those satellites made their data well suited for use in developing databases for hazard risk assessment. The type of information that would be generated from the images of the satellites could include topographical maps, land-use maps and maps of highways and other access roads. Since the satellites also provided repetitive coverage over the same areas, use of their data made it possible to conduct change detection studies. Such studies could, for instance, determine the change in the degree of moisture of vegetation with the passage of time during dry spells. Such information would be basic for issuing forest fire warnings and for taking preventive and readiness measures.

49. Launched in July 1991, the first European Remote Sensing Satellite (ERS-1) could measure wind speed in the range of 4 to 24 metres per second. ERS-1 was equipped with several microwave sensors on board. The primary instrument was the Active Microwave Instrument (AMI), which could operate in imaging mode as a synthetic aperture radar and provide high-resolution images in C-band (4.20 to 5.75 gigahertz). Because microwave radiation suffered very little attenuation in passing through clouds and even light rainfall, ERS-1 could provide images of the tropical areas which heretofore could not be thoroughly mapped with Landsat and SPOT because of the almost constant presence of clouds in the region.

50. Operating in wind mode, AMI could provide wind speed through ocean wave spectrum analyses and through the length and direction of the ocean waves. Wind speed and direction were determined by measuring the strength of the back-scattered signal from each resolution element on the surface of the sea, looking at it from three directions - obliquely ahead, to the side and obliquely behind the path of the satellite. The intensity of the three signals provided the wind speed, and the differences between them provided the wind direction with an accuracy of 20 degrees.

51. In addition to AMI, ERS-1 carried a Radar Altimeter that operated at a wavelength of 2 centimetres. The altimeter looked vertically downward to measure wave height and wind speed and to determine the mesoscale ocean topography. ERS-1 also carried an Along-Track Scanning Radiometer (ATSR) that operated in three bands in the middle and thermal infrared region of the electromagnetic spectrum; those bands were centred around 3.7, 11, and 12 micrometres. ATSR looked through the atmosphere at the surface of the ocean from two directions, downward vertically and at an incidence angle of 50 degrees. The difference between the oblique and vertical measurements provided information on atmospheric absorption. In particular, the differences between the measurements were used to determine the atmospheric water vapour content.

D. Characteristics and use of Geographic Information Systems

52. GIS was an important tool for analysis of large quantities of information and for subsequent decision-taking. Once the information derived from remote-sensing data was used for the application for which it was intended, it became ancillary information or raw data that could be used with other information in GIS for management decisions. Sources of data that could be put into GIS were the following: remotely sensed data, thematic maps derived from such data, point measurements such as field-obtained data, existing cartography or census-type data. The important characteristic of GIS was that all the data contained in it had a positional reference, usually geocoded to corresponding points on the surface of the Earth.

53. GIS could be defined as consisting of the three following elements: a large amount of data which had spatial or locational characteristics; an integrated set of computer programs which distinguished GIS from a collection of unrelated programs; and a common set of sub-components which performed operations such as data storage, retrieval, analysis and display. From a users point of view, GIS was a relational type of database, spatially indexed in such a way that new information can be added from external sources or created from existing information.

54. GIS could be visualized as consisting of a number of layers or planes, each of which contained thematic information on one or more variables over the surface area being considered. Through user queries, GIS could superimpose all or a subset of the layers and report the results of the query in the form of a tabular or statistical report, or as an image on a television monitor from which a hard copy could be made or in digital form on a magnetic tape from which a map-like product could be generated.

55. An important use of GIS was for analysis with predictive models. While such analyses would not indicate actual future conditions, they would be capable of indicating the conditions that might be expected if a particular trend (such as land degradation) continued at the current rate, or if particular climatic conditions occurred (such as drought or flooding associated with the El Niño phenomenon).

E. Use of space data to determine the onset of El Niño

56. Phenomena like El Niño, affected climate on a regional and global scale, often with disastrous consequences. During the 1982-1983 episode of El Niño, Peru suffered losses of US$ 2 billion and a decline of 13 per cent in its gross domestic product.

57. The onset of El Niño could be monitored to a large extent by determining the ocean surface temperature and wind velocity. The data to determine the values of those parameters were provided by the meteorological satellites (sea surface temperature (SST)) and by ERS-1 (wind velocity). Under normal circumstances, SST of the Western Equatorial Pacific (adjacent to Australia) was 29 degrees centigrade, while in the Eastern Equatorial Pacific (adjacent to Ecuador and Peru) SST was 22 degrees centigrade, in other words, there existed a thermal gradient of 7 degrees centigrade. Also, under normal circumstances the winds were predominately easterly. The easterly winds flowed west from the coast of South America as surface winds until they reached the vicinity of the meridian of 165 degrees. Around that longitude there was an inter-tropical convergence area which, together with the higher water temperature, resulted in an upward flow. At some height, there was a reversal of wind flow direction towards South America; that closed the loop known as Walker's circulation.

58. The onset of El Niño occurred when SST close to the coast of South America was higher than normal. That caused a lower wind velocity and even a reversal of the easterly winds. The weakening of Walker's circulation was accompanied by a rising of the thermocline off the coast of Australia and its deepening off the coast of South America. The anti-cyclonic region in the South Pacific weakened and the inter-tropical zone was displaced southward. All that resulted in an altered atmospheric system with warmer air temperatures in the northern Pacific region of South America, bringing with it flooding and drought episodes. Although the phenomenon can not be prevented, meteorological and radar satellites could provide, at a low cost and in a timely manner, the necessary information for an early warning system.

F. Search and rescue services

59. The Space System for Tracking Ships in Distress (COSPAS)/Search and Rescue Satellite Tracking System (SARSAT) was a cooperative programme of Canada, France, Russian Federation and United States that provided assistance in search-and-rescue operations for maritime, aeronautical and land vehicles anywhere in the world. Beacons fitted to the vehicles sent a distress signal to one of four satellites that were operated by the Russian Federation and the United States. The satellites processed or relayed the distress signal to a mission control centre where the beacon positions were determined. The information was forwarded from those centres in the form of an alert to rescue coordination centres. To date, the COSPAS/SARSAT programme had been instrumental in saving more than 3,000 lives.

60. Communications by satellite were vital to the success of the COSPAS/SARSAT programme. Studies had shown that when the victim of an aircraft accident needed to wait for more than two days, the probability

of survival was only 10 per cent. The probability rose to 80 per cent if the rescue took place within eight hours. At sea, a quick response was even more critical. Mean survival time was highly dependent on sea water temperature. Mean survival time in water at 5 to 10 degrees centigrade was less than three hours; it is less than six hours in water at 10 to 15 degrees centigrade, and less than 12 hours in water between 15 to 20 degrees centigrade.

G. A global monitoring and warning system

61. With current achievements in remote sensing, mobile satellite communications and data processing, the use of space technology for disaster warning and relief purposes had become more feasible than ever. Existing technology was sufficient, but a global approach and international cooperation was required.

62. A concept of creating a global monitoring system to provide disaster warning and relief support and to diminish the impact of disasters on human society was developed during the 1993 summer session of the International Space University. The concept was presented as a proposal to the international community involved in space activities as well as those involved in disaster prevention and the mitigation of their effects. As presented, the GEOWARN system would be accessible to all countries for humanitarian purposes and operated as a non-profit international consortium of government shareholders. GEOWARN would be implemented as a phased system over the next decade making maximum use of existing and already planned infrastructure.

63. Information and communication would be the main services provided by the GEOWARN organization, as it would not coordinate relief efforts or provide aid. Information would be provided prior to disasters for planning purposes, immediately before the disaster, if possible, to give the alarm, and after the disaster, to provide links between the disaster area and the outside world.

64. The primary users of the System would be Governments of affected countries and international disaster and relief organizations. Local authorities, emergency agencies, relief agencies and the news media would be secondary users. Other users who would have access for humanitarian research activities would include universities, research institutes and possibly commercial enterprises.

65. After processing and interpreting data collected from Earth-observing satellites and aircraft, information would be distributed for planning purposes to requesting Governments. During a crisis, the relevant information would be offered to the affected government for subsequent transmission to the local field centres and relief teams in the disaster area.

H. Actions by the United Nations in disaster-related matters

66. The Department of Humanitarian Affairs (DHA) was the specialized office of the Secretariat responsible for all disaster-related matters. One of its main functions was to mobilize, direct and coordinate external assistance provided by the United Nations system in response to disasters. DHA also promoted pre-disaster planning as well as the study, prediction, prevention and control of natural disasters.

67. The secretariat of the International Decade for Natural Disaster Reduction (IDNDR), 1990-2000, opeated within the framework of DHA. The Decade was proclaimed by the General Assembly with a view to reducing, through concerted international actions, the loss of life, property damage and social and economic disruption caused by disasters such as tsunamis, floods, landslides, volcanic eruptions, forest fires, pest infestations, droughts and desertification and other calamities, particularly in the developing countries.

68. The activities of the Decade were designed to achieve the above-mentioned objective by the following means:

(a) Improving the capacity of each country to mitigate the effects of natural disasters expeditiously and effectively, paying special attention to assisting developing countries in the assessment of potential damage caused by disasters and in the establishment of early-warning systems and disaster-resistant structures when and where needed;

(b) Devising appropriate guidelines and strategies for applying existing scientific and technical knowledge, taking into account the cultural and economic diversity among countries;

(c) Fostering scientific and engineering endeavours aimed at closing critical gaps in knowledge in order to reduce loss of life and property;

(d) Disseminating existing and new technical information related to measures for the assessment, prediction, and mitigation of natural disasters;

(e) Developing measures for the assessment, prediction, prevention and mitigation of natural disasters through programmes of technical assistance, technology transfer, demonstration projects and education and training, tailored to specific disasters and locations and to evaluate the effectiveness of those programmes.

69. In defining specific targets for the Decade, the IDNDR Scientific and Technical Committee considered that the Decade called primarily for action at national level, with supporting action at regional and global levels.

70. Thus, by the year 2000, all countries, some through regional arrangements, should have in place the following:

(a) A national assessment of risk, including an overall identification of those natural hazards which pose a disaster threat; for each type of hazard threat, an evaluation of the geographic distribution of the threat and estimates of its recurrence frequency and of its impacts; and an estimate of vulnerability of the most important concentrations of population and resources;

(b) National and local prevention and preparedness plans, including adoption of land-use and construction practices to resist or avoid hazards; adoption of emergency-response plans that identify responsible organizations, hazard scenarios and essential actions; awareness programmes to educate people on the nature of the threat, including a training component; and concrete measures to mitigate damage and increase resilience in case of a disaster.

Annex

PROGRAMME OF THE WORKSHOP

Date	Time	Subject	Speaker
Monday 27 September	0900-0945	Opening ceremony	A. A. Abiodun, United Nations V. Hood, European Space Agency E. Mendez, Director General, Instituto Mexicano de Comunicaciones
		Keynote address	
	1000-1040	Disaster risk assessment and preparedness programmes in Mexico	E. Cordero R. García, Mexico
	1040-1120	The role of space technology in the International Decade for Natural Disaster Reduction	J. Scott, DHA
		Availability of satellite data	
	1140-1220	Characteristics of low- and high-resolution satellite data and sources where they can be obtained	M. Dominguez, Ecuador
		Weather monitoring and forecasting	
	1400-1440	Tracking of severe storm and weather patterns	C. Berridge, CARICOM
	1440-1520	Use of ERS-1 data to derive sea-surface wind charts for improved weather forecasting	M. Fea, ESA
	1540-1620	Monitoring and early warning of the onset of El Niño	M. Valverde, Peru
		Building a database for disaster risk assessment and relief planning	
	1620-1700	The Global Positioning System: a tool for regional tectonic stress determination	J. Tanner, Canada

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Tuesday 28 September	0900-0940	Development of a seismic risk map for the Americas	J. Tanner, Canada
	0940-1020	Use of SAR data to map the extension of flooded areas	M. Fea, ESA
	1040-1120	Use of Earth observation satellites in natural disaster prevention and monitoring - Argentina's experience	S. Leguizamon, Argentina
	1120-1200	Integration of a GIS-assisted database for disaster prevention and relief operations	A. Gimenez, Spain
	1400-1440	Use of a GIS to create and update hazard vulnerability maps (floods, landslides, earthquake zones, forest fires)	C. Patillo, Chile
	1440-1520	The Caribbean Emergency Response Mechanism	J. Collymore, CDERA
	1540-1700	Visit to the facilities of the Institute of Geography, National University of Mexico	R. Alvarez, Mexico
Wednesday 29 September	0900-0940	The use of INMARSAT in disaster relief and emergency assistance operations	E. Staffa, INMARSAT
	0940-1020	Demonstration of the operation of the INMARSAT-M terminal	E. Staffa, INMARSAT
	1040-1120	The use of the Argos System for monitoring and prevention of natural risks	C. Vassal, National Centre for Space Studies
	1120-1200	Seismic Alert System	J. M. Espinosa, Mexico
	1200-1240	Use of the Solidaridad satellites to re-establish communications following a disaster	R. Estrada, J. Roch, Mexico
	1400-1440	GEOWARN: A concept for a Global Emergency Observation and Warning System	P. Osterman, ESA
	1440-1520	The need for an international convention on disaster communications	J. Scott, DHA

Date	Time	Subject	Speaker
	1520-1730	Working group (parallel discussions) Co-chairpersons: C. Patillo (Chile) M. Chang (Guatemala) Themes: Elements of a disaster risk assessment, prevention and relief system Elements of an emergency disaster relief communications system Sharing of disaster-related data and information	
Thursday 30 September	0900-1200	Working Group (continued)	
	1400-1600	Discussion and adoption of the recommendations Co-chairpersons: S. Camacho (United Nations) J. Roch (Mexico)	
	1630-1700	Closure	United Nations/ESA, Mexico